CLAIMS:

1. An optically encoded particle (10, 10a), comprising:

a layer of material; and

porosity within the layer of material configured to produce an interference pattern in the reflectivity spectrum that forms an optical signature including a detectable grey scale code.

2. The particle of claim 1, wherein the particle has a diameter of hundreds of microns or less.

3. The particle of claim 1, wherein said porosity is formed in accordance with an etching waveform, and there is a correspondence between sine components of the etching waveform and a spectral position and height of peaks in Fourier transformed k-space of said interference pattern.

4. The particle of claim 3, wherein said interference pattern in the reflectivity spectrum extends beyond the visible spectrum.

5. The particle of claim 3, wherein the height of the spectral peaks correspond to sine components' amplitudes.

6. The particle of claim 1, wherein said material comprises a semiconductor.

7. The particle of claim 6, wherein said semiconductor comprises silicon.

8. The particle of claim 1, wherein said first porous layer and said n additional porous layers are formed from an insulator.

9. The particle of claim 1, further comprising a receptor for binding a predetermined analyte.

10. An optically encoded particle (10, 10a), comprising a thin film in which porosity varies in a manner to produce an optical signature detectable in the reflectivity spectrum that when converted to Fourier k-space exhibits a grey scale code.

11. The particle of claim 10, further comprising a receptor.

12. The particle of claim 11, wherein said receptor is a receptor for a biological analyte.

13. The particle of claim 11, wherein said receptor is a receptor for a chemical analyte.

14. The particle of claim 11, wherein said receptor is a receptor for a gaseous analyte.

15. The particle of claim 10, further comprising a fluorescence tag for assaying the particle.

16. The particle of claim 10, wherein the thin film comprises porous silicon.

17. The particle of claim 10, being micron-sized.

18. A method for encoding thin films, comprising steps of:

etching a semiconductor or insulator substrate to form a thin film including pores;

varying etching conditions to vary porosity in the thin film according to a pattern that will generate an optical signature in the reflectivity spectrum in response to illumination, the optical signature including a grey scale code.

19. The method of claim 18, wherein said step of varying comprises applying an etching waveform formed by the addition of at least two separate sine components in accordance with $y_{comp} = [y_1 + . . . + y_n]/n$, where y_n are the sine components.

20. The method of claim 18, wherein the grey scale code is revealed in naturally optically converted k-space.

21. The method according to claim 18, further comprising a step of separating the thin film from the semiconductor or insulator substrate.

22. The method according to claim 18, further comprising a step of separating the thin film into particles.

23. The method according to claim 18, further comprising a step of placing a particle within a host.

24. The method according to claim 18, further comprising steps of:

generating an interference pattern in the reflectivity spectrum by illumination of one or more of the particles;

determining a particle's code from the position and heights of peaks in k-space.

25. The method according to claim 18, wherein said step of varying etching conditions varies the etching conditions according to sine component equations.

26. The method according to claim 18, further comprising a step of spatially defining the semiconductor or insulator substrate to conduct said step of etching in a spatially defined location or locations.

27. The method according to claim 26, wherein said step of varying further varies etching conditions in different spatially defined locations to encode multiple codes in the thin film.

28. The method according to claim 27, further comprising a step of separating the thin film from the semiconductor or insulator substrate.

29. The method according to claim 28, further comprising a step of separating the thin film into particles.

30. A method for identification of an analyte bound to an encoded particle or identification of a host including an encoded particle of claim 10, the method comprising steps of:

associating the encoded particle with the analyte or the host;

generating an interference pattern in the reflectivity spectrum by illumination of the particle;

determining the particle's code from the interference pattern;

identifying the analyte or the host based upon said step of determining.

31. The method according to claim 30, further comprising a step of designating the particle to bind an analyte by modifying the particle with a specific receptor or targeting moiety.

32. The method according to claim 31, wherein the targeting moiety is a sugar or polypeptide.

33. The method according to claim 32, further comprising a step of signaling binding of an analyte by fluorescence labeling or analyte autofluorescence.

34. A method of encoding micron sized particles, the method comprising steps of:

etching a wafer to form a thin film having a varying porosity that will produce a detectable optical signature grey scale code in response to illumination;

applying an electropolishing current to the wafer to remove the porous film from the wafer;

dicing the film into micron-sized particles, each micron-sized particle maintaining an optical signature produced by said step of etching.

35. The method according to claim 34, further comprising a step of modifying the particles with a specific receptor or targeting moiety.

36. An encoded micron-sized particle (10, 10a) having a grey scale code embedded in its physical structure by refractive index changes between different regions of the particle.

37. The particle of claim 36, further comprising a receptor.

38. The particle of claim 37, wherein said receptor is a receptor for a biological analyte.

39. The particle of claim 37, wherein said receptor is a receptor for a chemical analyte.

40. The particle of claim 37, wherein said receptor is a receptor for a gaseous analyte.

41. The particle of claim 37, further comprising a fluorescence tag for assaying the particle